Title: Dr. **Family Name:** BEER
Given Name: Reinhard
Institution: Jet Propulsion Laboratory
California Institute of Technology
Address: M/S 183-301
The Jet Propulsion Laboratory
4800 Oak Grove Drive
PASADENA, CA
Country: USA **Post Code:** 91109 **Phone No.:** (818) 354 4748
Fax No.: (818) 393 4445 **Email Address:** Reinhard.Beer@jpl.nasa.gov
Presentation Preference: Oral
Preferred topic number: C9
Abstract title: Tropospheric Emission Spectrometer for the EOS AURA Satellite
Name of author(s): Reinhard BEER
Helen M. WORDEN
Corresponding author: Reinhard Beer
Abstract:

The issue of the global 3-dimensional distribution of tropospheric ozone is gaining in importance as its central role in tropospheric chemistry becomes increasingly evident.

Ozone is produced in the troposphere by photochemical oxidation of carbon monoxide (CO) and hydrocarbons in the presence of nitrogen oxides (NO_x) and water vapor. These ozone precursors have both natural and anthropogenic sources. The chemistry of ozone is complex and tightly coupled to the atmospheric transport of both ozone and the precursors.

Tropospheric ozone has three major environmental impacts:

1) AS AN AIR POLLUTANT. Ozone in surface air is toxic to humans, animals and vegetation. It is the principal harmful component of smog.

2) AS A CLEANSING AGENT. Photolysis of ozone in the presence of water vapor is the primary source of the hydroxyl radical (OH), which is the main oxidant in the atmosphere. Reactions with OH in the lower and middle troposphere are the principal sink for a large number of environmentally-important species including air pollutants (carbon monoxide), greenhouse gases (methane), and gases depleting the stratospheric ozone layer (HCFC's, methyl halides).

3) AS A GREENHOUSE GAS. Ozone in the middle and upper troposphere is an efficient greenhouse gas. Perturbation of ozone in this region of the atmosphere results in heterogeneous radiative forcing with complicated implications for climate.

Tropospheric ozone is believed to have increased as a consequence of human activity (primarily because of combustion processes). Whether this increase in tropospheric ozone is beneficial (cleansing agent) or harmful (air pollutant, greenhouse gas) depends to a large extent on its altitude. It is very important, therefore, to map the global 3-dimensional distribution of

tropospheric ozone and its precursors in order to improve our understanding of the factors controlling ozone in different regions of the troposphere.

The Tropospheric Emission Spectrometer (TES), selected for flight on the EOS AURA satellite in June 2003, will provide the first comprehensive global view of the chemical state of the troposphere. The investigation will focus on mapping the global distribution of tropospheric ozone and on understanding the factors that control ozone concentrations.

TES is an infrared, high resolution, Fourier Transform spectrometer covering the spectral range 650 - 3050 cm^{-1} (3.3 - 15.4 μm) at a spectral resolution of 0.1 cm^{-1} (nadir viewing) or 0.025 cm^{-1} (limb viewing). The two observation modes are essential because many of the spectral features that TES observes are very weak (especially the nitrogen oxides) and limb-viewing markedly enhances their measurability (with the deficiency that cloud interference is much more likely than in nadir viewing).

In order to improve signal-to-noise ratio and improve collection efficiency, TES is (as far as possible) radiatively-cooled to ~180K and divides the spectral range into 4 sub-regions each observed with a separate 1x16 array of detectors actively cooled to 65K. The bandwidth is further restricted to ~250 cm^{-1} by interchangeable filters. With these arrays, 16 altitudes in the troposphere and lower stratosphere are observed simultaneously with a height separation of 2.3 km or, alternatively, 16 contiguous areas, each 0.5 x 5 km, are observed on the ground.

TES obtains its data in 4 seconds (nadir) or 16 seconds (limb) plus calibrations in a sequence: 2 calibrations followed by 2 nadir observations followed by 3 limb observations. The entire cycle requires 81.2 seconds and is repeated continuously with the only interruptions being major calibration-only sequences (essential for this type of instrument) and occasional targets-of-opportunity such as volcanic eruptions, biomass burning regions or regional ozone episodes for which TES has unique capabilities.

It is a property of a Fourier Transform Spectrometer that it must be used in a so-called "staring" mode (that is, the target location or altitude must be tracked). Accordingly, TES is equipped with a precision pointing system.

The specific Standard Products that TES will produce are global-scale vertical concentration profiles (0 - ~33 km) of ozone, water vapor, carbon monoxide, methane, nitric acid, nitric oxide and nitrogen dioxide (the last two in the mid- and upper troposphere only). Essential by-products of the analysis are atmospheric temperature profiles and surface temperature and emissivity. The ultimate goal, of course, is to assimilate TES and all other sources of atmospheric data into a global chemistry model with predictive capability (a "chemistry forecast") and some initial steps along this path are being taken.

The research described in this abstract was carried out by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.